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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/926,188	09/20/2001	Toshihiro Ando	011147	4371

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EXAMINER

SONG, MATTHEW J

ART UNIT	PAPER NUMBER
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1765

DATE MAILED: 03/13/2003

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Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/926,188

Applicant(s)

ANDO ET AL.

Examiner

Matthew J Song

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 07 January 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-4, 6, 7 and 20 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-4, 6-7, and 20 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.  
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All b) ☐ Some \* c) ☐ None of:  
1. ☐ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).  
\* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).  
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

## DETAILED ACTION

### *Claim Rejections - 35 USC § 103*

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 1-4, 6-7 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Imai et al (US 5,001,452) in view of Imai et al (JP 01-103994), an abstract of JP 01-103994 has been provided, along with Jin et al (US 5,977,697).

Imai et al ('452) discloses a method of forming a n-type diamond semiconductor (col 1-8) using a reaction gas composed of  $\text{CH}_4$ ,  $\text{H}_2\text{S}$  and  $\text{H}_2$  to form S-doped diamond films on the (100) face of a single crystal diamond substrate by microwave plasma assisted CVD process (Example 1) with a electron mobility of  $590 \text{ cm}^2/\text{V}\cdot\text{s}$  (Table 1).

Imai et al ('452) does not disclose mechanically polishing a diamond substrate to make it an inclined diamond substrate.

In a method of growing a diamond single crystal free from defects and having a smooth surface by specifying the orientation of the growth face of the substrate, Imai et al (JP '994) teaches a diamond single crystal layer is grown on a diamond single crystal substrate in a vapor phase, where a polished face having less than a  $8^\circ$  angle to the face orientation of (111) or (100) face is used as the growth face of the substrate and by this method a diamond single crystal layer having satisfactory crystallinity and a flat surface can easily be produced (Abstract).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Imai et al ('452) with Imai et al (JP '994) to grow of crystal of diamond free of defects and having a smooth surface.

The combination of Imai et al ('452) and Imai et al (JP '994) does not disclose subjecting a surface of the inclined diamond substrate to a smoothening treatment making it even.

In a method of forming diamond emitters, note entire reference, Jin et al teaches a diamond thin film is loaded into a microwave plasma chamber for surface treatment, this reads on applicant's smoothening treatment, where the plasma was pure hydrogen and the plasma chamber was operated at a microwave power of 1 kW (1000 W) and a total pressure of 20 Torr, a substrate temperature of 700°C and plasma exposure for 60 minutes. Jin et al also teaches after the treatment process the sample was subjected to a diamond overcoat process in the plasma chamber using methane gas at a substrate temperature of 700°C (col 9, ln 45-67). Jin et al also teaches the hydrogen plasma cleans the diamond surface by removing carbonaceous and oxygen or nitrogen related contaminants and also introduces hydrogen-terminated diamond surface and the plasma also removed any graphite or amorphous carbon phases present on the surface and along the grain boundaries (col 5, ln 15-67).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Imai et al ('571) and Imai et al (JP '994) with Jin et al to clean the surface and remove amorphous phases, thereby improving crystallinity.

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Referring to claim 1-2, the combination of Imai et al ('571), Imai et al (JP '994) and Jin et al teaches a similar method of making a n-type semiconductor diamond as applicant. the combination of Imai et al ('571), Imai et al (JP '994) and Jin et al is silent to the crystalline perfectness, the Raman peak, a Kikuchi pattern, carrier concentration and carrier mobility of the n-type diamond. It is inherent to the n-type diamond taught by the combination of Imai et al ('571), Imai et al (JP '994) and Jin et al to have same because the combination of Imai et al ('571), Imai et al (JP '994) and Jin et al teaches a similar method of forming a n-type diamond as applicant.

Referring to claim 3, the combination of Imai et al ('571), Imai et al (JP '994) and Jin et al teaches a polished inclined diamond substrate with an angle of less than 8° and smoothening the substrate prior to deposition of a n-type diamond by microwave plasma.

Referring to claim 4, the combination of Imai et al ('571), Imai et al (JP '994) and Jin et al teaches a (100) orientated substrate.

Referring to claim 6, the combination of Imai et al ('571), Imai et al (JP '994) and Jin et al teaches a pressure of 20 Torr, a microwave output of 1000 W, a temperature of 700°C for a period of 1 hour.

Referring to claim 7, the combination of Imai et al ('571), Imai et al (JP '994) and Jin et al teaches a temperature of 700°C.

Referring to claim 20, the combination of Imai et al ('571), Imai et al (JP '994) and Jin et al teaches a temperature of 700°C. Temperature is well known in the art to be a result effective variable, note Tsuno et al (US 5,474,021) below. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Imai et al ('571), Imai et al (JP '994) and Jin et al by optimizing the

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temperature by conducting routine experimentation of a result effective variable (MPEP 2144.05).

### *Response to Arguments*

6. Applicant's arguments filed 1/7/2003 have been fully considered but they are not persuasive.

In response to applicant's arguments that the claimed step of mechanically polishing a diamond substrate to make it an inclined diamond substrate is not taught or suggested by the prior art is noted, but has not been found convincing. Imai et al ('994) teaches polishing a substrate to have less than an 8° angle to the face orientation, which encompasses applicant's range of angles of 1.5-6°, entirely. When the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d 257, 191USPQ 90 (CCPA 1976). In order to rebut a prima facie case of obviousness based on overlapping ranges, the applicant must show that the particular range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range." In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir.1990). No evidence of the criticality of the ends of the claimed range has been shown. Applicant has attempted to show an unexpected result for a 0° angle; however no unexpected result showing the criticality of 1.5° or 6° has been provided. Furthermore, Imai et al teaches explicit examples of a 2° angle with the (111) plane and a 5° angle with the (100) plane, note table 1.

In response to applicant's argument that the references fail to show certain features of applicant's invention (pg 9, third paragraph and page 11, second paragraph), it

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is noted that the features upon which applicant relies (i.e., n-type diamond applicable to a p-n junction device) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

In response to applicant's argument that S or Se **might** cause a Frenkel defect rather than substitution in regular carbon lattice sites and this **may** also serve to create donor levels has been considered but has not been found persuasive. Applicant's arguments are based on possible scenarios, which **may** or may not occur. There is no evidence provided, which shows the Imai et al ('452) reference would not be able applicable to a p-n junction device. Furthermore, the combination of Imai et al ('571), Imai et al (JP '994) and Jin et al teach a similar method of forming a n-type semiconductor, as applicant, therefore a n-type of similar properties will inherently be formed, absent evidence to the contrary.

In response to applicant's argument that the motivation to combine the references does not appear to come from the references themselves is noted (page 6, last paragraph), but has not been found persuasive. The motivation to modify Imai et al ('452) with Imai et al (JP '994) to grow of crystal of diamond free of defects and having a smooth surface is taught by Imai et al ('994) in the English abstract. Also, the motivation to modify the combination of Imai et al ('571) and Imai et al (JP '994) with Jin et al to clean the surface and remove amorphous phases is taught by Jin et al in column 5. Furthermore, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made,

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and does not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971).

### ***Conclusion***

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Tsuno et al (US 5,474,021) teaches the temperature and growth plane of a substrate are result effective variable for the growth of diamond single crystal by microwave plasma CVD (Example 1).

8. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.



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9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J Song whose telephone number is 703-305-4953. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin L Utech can be reached on 703-308-3868. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

Matthew J Song  
Examiner  
Art Unit 1765

MJS  
March 12, 2003

  
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